Revista del Instituto Español de Estudios Estratégicos
ISSN-e: 2255-3479

Santiago García Peña
PhD in International Security. General Gutiérrez Mellado University Institute (UNED)

E-mail: santiago.garcia.am@gmail.com

An Empirical analysis of international collaboration in the provision of Defence assets: Advantages and Limitations

Abstract

Despite the fact that collaboration in European armaments programmes has existed for more than seventy years, the difficulties facing such collaboration persist. These include the harmonisation of requirements and building consensus, generally motivated by national interests, preferences and budgetary priorities that do not match those of prospective partners. This study of the potential advantages and the main drawbacks inherent in international collaboration programmes, together with an analysis of cases of success and failure in Europe, leads us to conclude that collaboration makes it possible to strengthen international security and defence relations, and share risks, efforts and resources in obtaining new, more advanced common capabilities that improve interoperability among allies. Furthermore such collaboration can also act as a catalyst for industrial restructuring that rationalises the number of main contractor companies, encourages specialisation and improves their international competitiveness.

Keywords

International collaboration; defence assets; states; defence industry; collaboration programmes.

To quote this article:

GARCÍA PEÑA, S. «An Empirical analysis of international collaboration in the provision of Defence assets: Advantages and Limitations». *Journal of the Spanish Institute for Strategic Studies,* n.º 15. 2020, pp. 295-232.

Introduction

Since the end of the Cold War, the European security environment has changed, with collaboration between the armed forces of different member states on prolonged missions abroad becoming more common, as a result of the EU's Common Security and Defence Policy (CSDP). The growing needs for military interoperability, insufficient national capabilities, increasing development costs, programme uncertainty and risks make collaboration in the procurement of defence goods advisable. However, in many cases the autarkic character of the member states prevails, with countries still opting for national developments, examples of which are the French *Rafale* or the Swedish *Gripen* fighter planes.

Against this background, this article analyses the advantages of state participation in international industrial collaboration programmes, as well as the main drawbacks, problems and limitations that may arise, through a review of cases of success and failure of this type of programme in Europe since the end of the 1960s.

The efforts of European collaboration

Some of the earliest traces of international collaboration on defence projects date back to 1945, with work performed by German scientists at the Berlin Institute of Ballistics alongside French scientists in fields such as ballistics, aerodynamics and electronic research[1]. From the 1950s onwards, a strong initiative emerged in favour of European industrial cooperation between states with the strongest technological, industrial and economic capabilities, due to concerns about low exports that could offset the rising unit costs of military equipment and systems[2]. Among the first projects were the agreement to manufacture the French military transport aircraft *Nord Noratlas* under licence on German soil in 1956; the manufacture of the long-range air reconnaissance aircraft, *Br. 1150 ATL*, with an initial agreement between France and Germany, in 1959, and the subsequent incorporation of Belgium, Holland and Italy; the Franco-German *MILAN* anti-tank guided missiles, in 1962; the joint Franco-German developments in *HOT* and *ROLAND* missiles; the *Alpha* light attack and advanced training aircraft, manufactured by the German company Dornier and the French Dassault-Breguet, with the flight of the first French prototype in 1973; and the entry into service of the Anglo-French *Jaguar* aircraft in the same year. These collaborations have promoted different industrial restructurings: mergers, such

1 WILLIS, F.R. France, Germany, and the New Europe, 1945-1967. California: Stanford University Press 1968, pp. 314-330.

2 WALKER, W.; GUMMETT, P. «Nationalism, internationalism and the European defence market». Chaillot Papers, 9. Paris: Institute for Security Studies of WEU 1993, pp. 22-25.

as EADS, MBDA; strategic alliances, such as *ANZAC Alliance*; consortiums, such as *Eurofighter GmbH* or *Euromissile*; or ad hoc agreements between member states for specific projects strengthening the industry at a European level. In parallel, at an institutional level, the idea of European collaboration in defence matters goes back to the efforts of integration at the beginning of the Cold War, before the establishment of the European Coal and Steel Community (ECSC) in 1951 which marked the beginning of the integration of Europe. These include the 1948 Treaty of Brussels, which led to the beginnings of the Western European Union (WEU); the 1963 Elysée Treaty between France and Germany to coordinate security and defence matters; the creation of the Independent European Programme Group (IEPG) in 1976 by the European NATO countries, except Iceland, which in 1992 became the Western European Armaments Group (WEAG), within the framework of the WEU; the creation of the Western European Armament Organisation (WEAO) and the Organisation for Joint Armament Cooperation (OCCAR) in 1996; the 1998 Letter of Intent (LoI) to restructure the defence industry, and the subsequent ratification of a Framework Agreement in 2000. In 2004, the European Defence Agency (EDA) was established to promote the CSDP[3] and to create a strong European Defence Technological and Industrial Base (EDTIB) with a view to fostering collaboration and strengthening the EU's security and defence capabilities. For its part, the European Commission, in a bid to encourage collaboration in research and the development of joint armament programmes, created the European Defence Fund (EDF) in 2017, and defined seventeen cooperative projects in March 2018, extended to thirty-four in November of the same year, based on joint spending on capabilities previously agreed by the member states to act as a catalyst for technological capability building in the EU.

Analysis of International Cooperation Programmes in Europe

This section provides an analysis of unsuccessful and successful examples of different collaborative programmes since the late 1960s.

Unsuccessful Cases

In most collaborative programmes, a variety of factors coincide, generated by the environment or as a result of unresolved disagreements, which can ultimately undermine them. The following table includes a review of some cases of failure, the main causes and the countries involved

3 Following the implementation of the Lisbon Treaty in December 2009, the European Security and Defence Policy (ESDP) was renamed the CSDP.

Programme	Countries	Main causes of failure	Consequence
VAK 191B[4]	Germany, Italy, UK	Disagreement on harmonisation of requirements. Increase in costs.	They only made three prototypes
Anglo-French Variable Geometry (AFVG)[5]	France, UK	Disagreement on harmonisation of requirements. Discrepancies in cost criteria	Cancelled
Main Battle Tank (MBT-70) [6]	Germany, USA.	Disagreement on harmonisation of requirements. Increase in costs	Cancelled
European Fighter Aircraft (EFA)[7] [8] [9]	Germany, France, UK, Italy, Spain	Disagreement on work-sharing. Purchase reduction due to budget restrictions.	France withdraws
NATO Frigate Replacement (NFR-90)[10] [11]	France, Italy, Germany, UK, Holland, Spain, USA., Canada	Large number of participating countries. Disagreement on harmonisation of requirements.	Cancelled
TRIGAT MR[12]	France, UK, Germany, Belgium, Netherlands	Delays in signing agreement by some countries. Reduction in the number of units requested.	UK & Netherlands withdraw
Horizon CNGF[13]	France, Italy, UK	Disagreement on harmonisation of requirements.	UK withdraws

4 FLIGHT INTERNATIONAL. «VAK 191B cancelled… Flight». International.com. 7/12/1972, p. 798. https://www.flightglobal.com/FlightPDFArchive/1972/1972%20-%203225.pdf.

5 WOOD, D. Project Cancelled: Disaster of Britain's Abandoned Aircraft Projects. London: Macdonald and Jane's Publishers 1975, pp. 202-204.

6 GLOBALSECURITY. «MBT-70/XM803». Globalsecurity.org. 2011. https://www.globalsecurity.org/military/systems/ground/mbt-70.htm.

7 The acronym EFA identifies the initial stage of the European fighter aircraft programme with the participation of France, whose withdrawal along with a reduction of the number of units almost brought about the cancellation of the programme. However, the remaining countries finally produced the Eurofighter.

8 TUCKER, J. B. «Partners and Rivals: A Model of International Collaboration in Advanced Technology». International Organization, 45 (1). 1991, pp. 112-115.

9 LORELL, M. A. The Use of Prototypes in Selected Foreign Fighter Aircraft Development Programs. Santa Monica, CA: RAND 1989, p. 12.

10 GLOBALSECURITY. NATO Frigate Replacement for the 1990s [NFR-90]. Globalsecurity.org, 2013. https://www.globalsecurity.org/military/world/europe/nfr-90.htm

11 RUIZ, R. M. «El último vástago del programa NFR-90». Revista Ejércitos, 5. 2010, pp. 30-47. https://issuu.com/ejercitos/docs/revista_ejercitos_n_5?q=NFR-90.

12 THINK DEFENCE. «Javelin Anti-Tank Guided Weapon (ATGW). UK Complex (Guided) Weapons – Reference». ThinkDefence.co.uk. 2018. https://www.thinkdefence.co.uk/uk-complex-weapons/javelin-anti-tank-guided-weapon-atgw/.

13 RUIZ, R. M. Op. cit., pp. 30-47. https://issuu.com/ejercitos/docs/revista_ejercitos_n_5?q=NFR-90.

Multi-Role Armoured Vehicle (MRAV)[14]	Germany, UK, Netherlands	Disagreement on harmonisation of requirements.	UK withdraws
Tonal Light Attack Helicopter (LAH)[15] [16]	Italy, Netherlands, Spain, UK	Disagreement on harmonisation of requirements. Poor coordination. Reduced national budgets. Withdrawal to acquire another system.	Cancelled
Modular Standoff Weapon (MSOW)[17] [18] [19]	Germany, Italy, UK, Spain, France, USA., Canada	Withdrawal of countries over disagreement work-sharing & costs. Disagreement on harmonisation of requirements. Inadequate national financing	Cancelled
Autonomous Precision Guided Munitions Programme (APGM) [20] [21]	Germany, France, Italy, Spain, Netherlands Turkey, USA., Canada	Disagreement on harmonisation of requirements. Inadequate national financing. Mismanagement due to number of states. Technology transfer problems.	Cancelled

Table I. Summary main causes of failure of programmes analysed.

Based on the data collected in the table above, the following graph represents a statistical analysis of the most common causes of programme failure, highlighting the disagreement on harmonisation of requirements, which is present in 83% of the programmes. In some cases, such as the *AFVG*, disagreement was due to the need for solutions with different roles and exclusive characteristics; in others, like the *NFR-90*, it was mainly due to the complexity of achieving unanimity in large groups, this being the case in forty-two percent of the cases analysed. In short, we are dealing with two sides of the same coin.

14 GLOBALSECURITY. «Multi-Role Armoured Vehicle (MRAV)». Globalsecurity.org. 2016. https://www.globalsecurity.org/military/world/europe/mrav.htm.

15 BRZOSKA, M.; LOCK, P. Restructuring of Arms Production in Western Europe. SIPRI Monographs. United States: Oxford University Press 1992, pp. 97-107.

16 DATAQUEST. Military Electronic Systems Markets. Dataquest. San José: CA 1991, pp. 92-93.

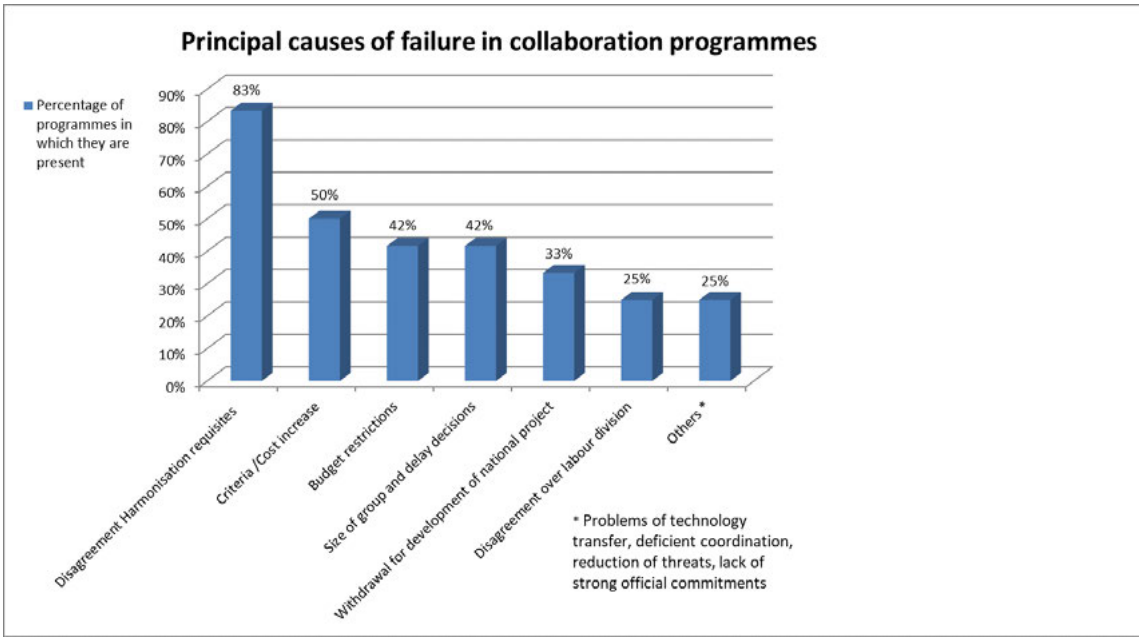
17 DATAQUEST. Op. cit., p. 94.

18 BLEAKLEY, G.A. International Armaments Cooperation: A Case Study of the Modular Standoff Weapons. Thesis. Ohio: Wright-Patterson Air Force Base 1988, pp. 3-7.

19 THINK DEFENCE. «Storm Shadow Conventionally Armed Stand Off Missile (CASOM)». ThinkDefence.co.uk. n.d. www.thinkdefence.co.uk/uk-complex-weapons/storm-shadow-conventionally-armed-stand-off-missile-casom/.

20 JOHNSON, E. L. Howitzer Ammunition System Procurement (HASP). Alexandria, Virginia: U.S. Army Material Command 1991, p. 73.

21 SMITH, D. Weaponry after the Gulf war - New equipment requirements for restructured armed forces. Document 1272, 14/05/1991, p. 23. http://aei.pitt.edu/53851/1/B0979.pdf.



Graph 1. Main causes of failure of programmes analysed. Source: Prepared by the author.

Another cause of failure highlighted in the collaboration programmes is the increase in costs, present in fifty percent of the cases, for example, in the *MBT-70* programme, caused by a lack of agreement on the requirements and by technical problems due mainly to the development of new experimental systems, in addition to budgetary restrictions present in forty-two percent of the cases. The withdrawal of states, present in one third of the programmes analysed, is in some cases more a consequence of the first three causes mentioned, as occurred with the *NFR-90* and *Horizon CNGF* frigates and the *MRAV* armoured vehicle. In the first case, countries withdrew to meet the needs of a new partnership programme, while in the remainder they did so to meet the needs of national programmes. In other cases, national programmes are one of the main causes of abandonment, as illustrated by the French government's abandonment of the *EFA* programme to develop the *Rafale;* or the UK and Netherlands' withdrawal from the *LAH* helicopter to acquire the *AH-64 Apache*. Finally, at the lower end of the graph, there are disagreements on the division of labour – one of the keys to France's withdrawal from the *EFA* – problems related to technology transfer, poor coordination and division of labour among the participants, a reduction of threats and the lack of serious official commitment.

These problems will be examined more closely in the section devoted to factors limiting collaboration programmes.

Success stories

There are also success stories in European collaboration programmes where, despite the limitations analysed in previous sections, the common interest of the countries involved has ensured that – despite adversity, delays and cost overruns – development and manufacture have been successfully completed (see table below).

Programme	Countries involved	Estimated orders European market	Exports (estimated orders)
Eurofighter (EF2000) [22]	Germany, United Kingdom, Italy, Spain	487	136
A400M [23] [24]	Germany, France, Spain, Turkey, United Kingdom, Belgium, Luxembourg	170	4 (+17 possible)
Tiger (EC665) [25]	France, Germany, Spain	184	22
NH-90[26]	France, Germany, Spain, Italy, Netherlands	440	103
COBRA [27] [28]	Germany, France	29	3

Table II. Success stories International Cooperation Programmes. Source: Prepared by the author

Notable examples include the *Eurofighter* programme, currently the largest European defence procurement programme with over 600 orders and the highest number from outside the EU (over 20 per cent of total orders). This programme has served to maintain and enhance the European fighter jet industry, achieve further consolidation of the aerospace sector and reduce dependence on the US. However, mainly due to collaboration agreements and technological complexity, it has had cost overruns of more than seventy-five percent over the initial estimate and delays of roughly fifty-four months; values which, on the other hand, are typical of modern weapons systems development projects (see table below), as was the case with the *A400M*, with cost overruns of around fifty percent over the initial estimate and delays of approximately four years due mainly to technical problems, similar to the rest of the European and North American programmes.

22 AIRBUS. «Orders, Deliveries, In Operation Military Aircraft by Country – WorldWide». Airbus.com. 30/04/2018. http://www.airbus.com/defence.html.

23 AIRBUS. Op. cit. http://www.airbus.com/defence.html.

24 JAARSMA, M. «A400M». Phantomaviation.nl. 2018. www.phantomaviation.nl/Aircraft/A400M.htm.

25 OCCAR. TIGER – A New Generation of Helicopters. 2018. www.occar.int/programmes/tiger.

26 JAARSMA, M. «NH90». Phantomaviation.nl. 2018. www.phantomaviation.nl/Aircraft/NH90.htm.

27 DEFENCEWEB. «First export success for the COBRA Radar in Gulf region». DefenceWeb.co.za. 25/02/2009. http://www.defenceweb.co.za/index.php?option=com_content&view=article&id=1165.

28 EURO-ART. «Roll-out of 29 COBRA Systems for France, Germany and the United Kingdom completed». thalesgroup.com. 2007. http://www.defense-aerospace.com/articles-view/release/3/85494/cobra-radar-deliveries-now-complete.html.

Programme	Estimated delay (months)	Estimated cost over-run
Eurofighter (collaboration) [29] [30]	54	75%
F/A-22 (USA.) [31]	117	127%
JSF (collaboration) [32]	30	50%
Submarine class *Astute* (UK) [33]	43	35%
A400M (collaboration) [34] [35]	48	40%-50%

Table III. Cost over-runs and delays different programmes.

In other cases, such as the *TIGER* or *NH-90* helicopter programmes, member states opted for the development of a common and versatile platform on which to incorporate modifications to develop different versions. In particular, the *NH-90* has been acquired by more than ten countries, including European allies that have previously collaborated in international programmes generating both industrial and military synergies. However, when the range of versions is very different, as for example in the case of the *F-35* fighter plane[36], it has meant a loss of efficiency in production, delays and cost overruns, mainly due to the large differences in the various versions, and not because it is a joint programme. In short, despite budgetary constraints, significant cost overruns and delays in the development of the programmes, in addition to varying national interests, the EU's desire to unify armament models, invest in the European defence industry and create highly skilled technological jobs, has favoured the success of cooperation agreements, as will be analysed in greater depth in the following section on the factors that promote collaboration.

29 NAO. Management of the Typhoon Project. Report by the Comptroller and Auditor General HC 755 Session 2010–2011. London: National Audit Office (NAO) 2011, p. 7.

30 NAO. Major Projects Report 2005. London: National Audit Office (NAO) 2005, p. 27.

31 GAO. Tactical Aircraft: Changing Conditions Drive Need for New F/A-22 Business Case. Report GAO-04-391. Washington: U.S. Government Accountability Office (GAO) 2004, p. 5.

32 GAO. Joint Strike Fighter - Strong Risk Management Essential as Program Enters Most Challenging Phase. Report GAO-09-711T. U.S. Government Accountability Office (GAO), GAO.gov., 2009, pp. 17-18. www.gao.gov/new.items/d09711t.pdf.

33 NAO. Op. cit., 2005, pp. 26-27.

34 REUTERS. «Airbus says A400M deal with buyers will limit future losses». Reuters.com. 07/02/2018. https://www.reuters.com/article/us-singapore-airshow-a400m/airbus-says-a400m-deal-with-buyers-will-limit-future-losses-idUSKBN1FR19Y.

35 EXPANSIÓN. «Airbus quiere revitalizar el A400M, el avión militar de los 20.000 millones». Expansion.com. 10/07/2018. www.expansion.com/empresas/transporte/2018/07/10/5b43be04268e3e2e428b460b.html.

36 Avión de combate diseñado en tres versiones distintas: F-35A, para despegue y aterrizaje convencional; F-35B, para despegues cortos y aterrizajes verticales; F-35C, variante naval para portaaviones.

Factors promoting international collaboration.

In the following sections, we examine the main driving factors behind international collaboration in defence programmes.

Operational

The growing need for a greater alignment of mission capabilities among partners and the opportunity for operational benefits from interoperability and standardisation of equipment and systems make operational capabilities one of the main reasons for collaboration and synergy in joint operations. Therefore, an excessive variety of systems – such as the high number of different models of fixed-wing aircraft deployed in NATO's Allied Force in Kosovo[37] – does not make sense, as it hinders interoperability between the armed forces of different States. However, a certain degree of diversity is necessary to allow for different complementary capabilities and to avoid dependence on a single weapons system. This balance can be achieved through an annual EU-wide defence review coordinated by the EDA which defines and harmonises the necessary capabilities, with the Council launching the appropriate collaborative projects, so that states can subsequently participate in Permanent Structured Cooperation (PESCO). The availability of common equipment helps to improve a rationalised approach to military interoperability capabilities by making it possible to obtain more spare parts, use the same type of ammunition or even develop a common military doctrine that reduces collective expenditure and avoids redundancies.

Technological and industrial

In terms of research, the life cycles of the different technologies are very diverse and becoming increasingly shorter in the field of information technology. Although a country can produce different technologies, the increased technological complexity of defence equipment and systems makes it difficult to develop new capabilities on an individual basis. In this scenario, cooperation makes it possible to take advantage of the diversity of resources among the member states, improve industrial capacity and reduce innovation cycles[38], and foster mutual trust for the development of new technologies and capabilities for future collaborative programmes. Greater diversity is always enriching. For example, with its participation in the *Eurofighter* programme

37 LARSON, E. et al. Interoperability of US and NATO Allied Air Forces: Supporting Data and Case Studies. RAND 2003, p. 81. www.rand.org/content/dam/rand/pubs/monograph_reports/2005/MR1603.pdf.

38 PISANO, G.P. «The R&D Boundaries of the Firm: An Empirical Analysis». Administrative Science Quarterly, 35 (1). 1990, pp. 153-176.

the UK improved its skills in airborne radar and defence devices, and its participation in the *A400M* enabled it to retain its leadership in wing design within the European Airbus consortium. Experience and confidence are acquired through collaboration; for example, the Turkish Engine Industry (TEI) was awarded a contract by the US multinational *Lockheed Martin* to manufacture parts for the *General Electric F136* engine in the JSF programme. The success of the contract allowed it to garner further engineering and manufacturing contracts with this same company[39], and as a result they were able to strengthen the relationships of trust between the parties resulting in the creation of social capital and the sharing of common values and interests, thus facilitating further cooperation.

Political

The participation of states in partnership programmes allows them to be perceived as a constructive partner in the common defence of an increasingly integrated EU across all areas. This partnership strengthens international security thinking and fosters a common defence culture, thus providing for sustained cooperative links and the strengthening of international ties. At European level, progress towards closer cooperation is reflected in both the creation of a common CSDP within the EU and the setting up of PESCO.

Economical

The average cost of defence systems and equipment has increased over the years, exceeding the average increase in GDP (see table below). This situation makes purely national developments less and less economically viable, with international collaboration becoming necessary to preserve military capabilities.

Arena et al. (2006, 5)		Arena et al. (2008, 11)	
Type of vessel	Annual growth	Type of aircraft	Annual growth
Amphibian ship	10,8%	Patrol	11,6%
Surface fighters	10,7%	Cargo	10,8%
Attack submarines	9,8%	Training	9,1%
Nuclear aircraft carriers	7,4%	Bomber	8,4%

39 GE AVIATION. «GE and TAI Extend Tusas Engine Industries, Inc. Joint Venture for Another 25 Years». GEAviation.com. 29/01/2010. https://www.geaviation.com/press-release/services/ge-and-tai-extend-tusas-engine-industries-inc-joint-venture-another-25-years.

	Attack	8,3%
	Combat	7,6%
	Electronic war	6,7%
	Inflation rates	
	IPC	4,3%
	DoD Purchase deflator*	3,8%
	PIB deflator	3,7%
*Ministry of Defence		

Table IV. Average increase in ship and aircraft costs and inflation rates, 1974 to 2005[40]

[41]In this sense, collaboration favours increased common investment in research and development, avoiding duplication of effort and encouraging greater production runs to take advantage of economies of scale through the common integration of equipment and systems that result in reductions per unit of approximately twenty percent in labour costs, and about ten percent of the total production cost by doubling manufacturing[42]. However, while economies of scale are achieved from a manufacturing point of view, there are also management overruns, which are proportional to the number of participating countries, as identified below under costs and delays for unanimous decision-making. On the other hand, collaborative programmes, such as the European *Eurofighter*, can have wider benefits, where the main partner companies (BAE Systems, Leonardo and Airbus), and the whole supply chain have led to the creation of around one hundred thousand highly qualified jobs at European level, in approximately four hundred companies[43], sharing technology and intellectual property rights, with national production lines for the part corresponding to each nation, in addition to lines of national integration - in particular four manufacturing lines. This illustrates how international programmes have not always sought efficiency, mainly due to national claims of commercial and industrial rights, as will be seen below in detail among the factors that limit international collaboration; allowing opportunities for the transfer of capabilities to other sectors and maintaining an internationally

40 ARENA, M.V. et al. Why Has the Cost of Navy Ships Risen? A Macroscopic Macroscopic Examination of the Trends in US Naval Ship costs over the Past Several Decades. Santa Monica, CA: RAND 2006, p. 5.

41 ARENA, M.V. et al. Why Has the Cost of Fixed-Wing Aircraft Risen? A Macroscopic Examination of the Trends in U.S. Military Aircraft Costs over the Past Several Decades. Santa Monica, CA: RAND 2008, p. 11.

42 HARTLEY, K. «The European Defence Market and Industry». En P. Creasey y S. May, (eds.), The European Armaments Market and Procurement Cooperation. London: Palgrave Macmillan 1988, p. 48.

43 INFODEFENSA. «Eurofighter Typhoon for Belgium - Media Guide, BAE Systems». Infodefensa.com. 07/10/2016, p. 6. https://www.infodefensa.com/archivo/files/161007_eurofighter_belgica%20(1).pdf.

competitive industry[44]. In this way, states can acquire more advanced weapons systems while sharing costs and risks.

Exports

Although the difficulty of exporting a developed product increases with the number of partners, mainly due to the time delay in Community decisions, this situation could be favoured if the member states were to agree on setting up an independent marketing organisation such as the European *Eurofighter* consortium, instead of engaging in export activities as individual partner companies trying to secure national sales, as occurred in the past with the *Tornado* fighter. In this way, the countries involved could use the sales networks of the companies in the partnership already established in certain regions of the world, facilitating access to potential customers and reducing trade costs[45]. For example, taking advantage of the good international relations between the United Kingdom and India, or Spain and the United Arab Emirates (UAE), so that the different export campaigns are led by the state with the best relationships backed by the countries participating in the cooperation programme.

Factors limiting international collaboration

In the following sections, we analyse the main drawbacks, problems and limitations encountered in international collaboration programmes.

Sovereignty and National Autonomy

Historically, there has been a strong national tradition in the defence industry where national interests and state support for large national companies with various types of assistance have existed in order to promote their development, consolidate their position and strengthen their competitiveness on the international market, creating so-called "national champions"[46], such as the French group Thales or the Italian industrial group Leonardo. In this way, supported by trade union lobbies, production companies and research centres, governments protect national productive autonomy

44 HARTLEY, K. The industrial and economic benefits of Eurofighter Typhoon. Reino Unido: Universidad de York 2006, pp. 25-26.

45 Para más información profundizar en el concepto de Piggyback, como fórmula de cooperación que aprovecha la estructura comercial de una empresa ya implantada en el país donde se pretende exportar.

46 TAYLOR, T. «West European Defence Industrial Issues for the 90's». Defence Economics, 4. 1993, p. 116.

by closing off the possibility of tenders from beyond their national borders – avoiding the possibility of international offers that are economically or technically more competitive[47] – based on the premise that sovereignty and national autonomy are violated by cooperation. However, defence systems and equipment increasingly require components acquired outside national borders due to technological complexity, as already discussed in the section on technological reasons for collaboration. Furthermore, the European Parliament and the Council establish, according to point 1 of Directive 2014/24/EU of 26 February 2014, that:

"The award of public contracts by or on behalf of Member States' authorities has to comply with the principles of the Treaty on the Functioning of the European Union (TFEU), and in particular the free movement of goods, freedom of establishment and the freedom to provide services, as well as the principles deriving therefrom, such as equal treatment, non-discrimination, mutual recognition, proportionality and transparency".

However, the rules on defence procurement provide for a derogation in Article 346(b) of the TFEU, as consolidated on 30 March 2010 (formerly Article 296 of the EC Treaty), corresponding to "production of (and trade in) arms and war material", which has permitted – to an increasingly reduced extent – non-compliance with Community principles of equality, non-discrimination or transparency. This has to some extent hampered the development of a single defence market and favoured the consolidation of the European defence industry. Apart from this exception, there have been increasing efforts by the Commission to create a European Defence Equipment Market (EDEM), which includes PESCO[48], the coordinated annual review on defence (CARD) and the EDF.

Harmonising requirements

While there is some similarity in the security policy priorities of European states (national security and defence, regional security and international stability), the divergence of high-level criteria, largely influenced by geostrategic location49 and foreign policies, has fuelled differences of opinion on the needs of the armed forces at European level. This situation turns the harmonisation of requirements into a complex

47 HARTLEY, K. The Economics of Defence Policy: A new perspective. London: Routledge 2011, pp. 170-175.

48 Although PESCO has other goals, such as intensifying cooperation between EU Member States in the field of security and defence – Articles 42(6) and 46, and Protocol 10 to the TFEU ref. 2012/C 326/01 of 26 October 2012 – it can contribute indirectly.

49 For example, the British Royal Navy has historically operated in harsher ocean conditions than the Italian Navy. The latter have had to provide short-term responses in Mediterranean and Gulf operations, opting for short-range naval air defence systems.

process and one of the main causes of failure of collaborative projects, as identified in the analysis of unsuccessful cases. The results obtained through identifying these high-level needs are used to define specific operational requirements based on operational, technological and industrial factors. In this process, adding an international dimension increases the complexity[50] and raises a variety of common considerations and challenges. For example[51]: different national models can define different solutions for a common scenario, and it is necessary to identify how the military requirements were derived in order to facilitate common harmonisation. The intransigence of states when it comes to abandoning certain national requirements generates extensive specifications that reduce the likelihood of compromise and lead to increased costs and technological and industrial complexity, thus favouring national industry by requiring services that only they can provide. When harmonisation cannot be achieved by agreement and it is considered inappropriate to comply with the rigidity of national requirements, it is possible to opt for the development of national variants on the basis of a common basic platform, with national modifications leading to increased unit development and production costs. States with inflexible budgets, lack of familiarity with the process of drawing up requirements, limited experience with development projects and the growth of associated costs may opt to purchase from third countries and implement the national modifications at a later date; they may also opt to develop a national programme.

Harmonisation of budget priorities and replacement schedules

While there is a degree of flexibility in the timetables for the replacement of weapons systems once they reach the end of their useful life, the alignment of equipment plans between different states is a problem that, together with changes in national budgetary priorities, has had a negative impact on collaboration programmes. For example, in 1992, due to the huge costs of German unification, the government announced its intention to abandon the *Eurofighter* programme[52]. In this scenario, we must add that there are marked differences between the useful life of the platforms, systems and technologies. For example, aircraft and ships have a service life of more than twenty years – in certain cases, such as the *B-52* bomber, more than fifty years – but less than ten years for weapons

50 HAYWARD, K. «Towards a European Weapons Procurement Process: The Shaping of Common European Requirements for New Arms Programmes». Chaillot Paper, 27. France: Institute for Security Study of WEU 1997, p. 14.

51 For further details, see: CATINGTON, R. C.; KNUDSON, O. A.; YODZIS, J. B. Transatlantic Armaments Cooperation: Report of the Military Research Fellows, DSMC 1999-2000. Fort Belvoir, VA: Defense Systems Management College 2000.

52 VOSS, W.; BRZOSKA, M. Eurofighter 2000: Consequences and Alternatives. Bonn-Germany: BICC 1996, pp. 10-14.

and sensor subsystems[53]. In the field of information technology, while on the one hand, there are activities, such as artificial intelligence, that have been under development for more than fifty years but only now beginning to show results, on the other hand, there are ongoing software updates that allow for the continuous improvement of security and optimise the performance of systems. In certain situations, such as low involvement in conflicts or reduced perception of threats, a difference of five years between replacement dates of systems from different states is no longer an insurmountable barrier to collaboration[54]. Nevertheless, the decision to wait depends mainly on both the conflict situation in which the country in question finds itself and the potential threat to which it could be exposed with obsolete or unsuitable equipment. It could temporarily opt for the purchase or lease of certain equipment or systems on a provisional basis, such as the tender issued by the Spanish Ministry of Defence in 2019 for the purchase of a training turboprop as an interim solution until a definitive solution can be found to replace the *C101*, the *F-5* and the *Pillan*[55].

Reduction in the number of orders

The future uncertainty of the development of a given programme, in the face of the potential for partner states to reduce the number of orders or withdraw from the programme, is another constraint on collaboration. In both cases, the estimated economies of scale are significantly reduced, generating situations of fragility that may lead to the total cancellation of the programme. For example, the reduction of the order by Germany for the *COBRA* system could have led to the cancellation of the programme as it meant a twenty-five percent increase in the unit production cost, a situation that meant negotiating a reduction in costs and an associated delay of forty-two months[56].

National Commercial and Industrial Rights Claims

States generally endeavour to ensure that commercial factors influence views on requirements so that the national industrial fabric achieves the highest value-added jobs and capabilities, with an overall share that is proportional to or exceeds the

53 NRAC. Life cycle technology insertion. Washington: The United States Naval Research Advisory Committee (NRAC) 2002, p. 27.

54 TAYLOR, T. Defence, Technology and International Integration. NY: St. Martin's Press 1982, p. 80.

55 DEFENSA. «La DGAM convocará un polémico concurso para comprar un avión que remplace a los C101 del Ejército del Aire». Defensa.com. 12/07/2019. www.defensa.com/espana/dgam-convocara-inminentemente-polemico-concurso-para-comprar.

56 NAO. Maximising the benefits of defence equipment co-operation. National Audit Office (NAO), Ministry of Defence, Report by the Comptroller and Auditor General, HC 300 Session 2000-2001. London: The Stationery Office 2001, p. 17.

capital provided. Thus, for example, in the EFA programme, the French State continuously insisted on getting a disproportionate share of the development work, but due to the refusal of the other countries involved, it ended up withdrawing to develop the Rafale nationally, as we have seen in the section on unsuccessful cases. Other countries, reluctant to share critical technological capacities, provoke situations of instability that lead to an unwillingness to collaborate. For example, in the JSF programme, US restrictions on sharing knowledge on critical technological capabilities generated such dissatisfaction in the other partners that they threatened to withdraw from the programme[57].Traditionally, in an attempt to resolve these conflicts over the division of labour, European procurement projects have been implemented according to the principle of juste retour [58], as illustrated with the Tornado and Eurofighter programmes. Industrial rights claims and work-sharing policies based on this principle complicate the elaboration of requirements and increase technological complexity as partners can request the development of technologies in areas where they lack the sufficient technical expertise required to improve their national capabilities[59] [60], posing considerable challenges in terms of distributing and allocating the load and value of the work. Furthermore, they may use this principle as a justification for having assembly lines in their own territory in order to guarantee industrial and commercial capacities, security of supply and protection of employment. This has led to the inefficient allocation of work, duplication of resources, production lines and necessary investment – such as in the Eurofighter programme – resulting in reduced economies of scale and increased production costs. This situation has not been repeated with the A400M which has only one assembly line. In short, the strategic nature of this sector means that industrial distribution at European level is not left in the hands of market forces alone, as there is a strong political and national interest in ensuring that this distribution is carried out in an appropriate manner, which requires the use of formulas such as the criterion of juste retour, which obliges industries to achieve a distribution of work according to the number of units that their country has agreed to acquire; industrial offsets, such as profits from the purchase of other types of goods, technology transfer or foreign investment, as was the case with the F-16 fighter[61]; or the Global Balance criterion, used by OCCAR in its collaboration programmes, which seeks to balance the member states' workload

57 GERTLER, J. J. «F-35 Joint Strike Fighter (JSF) Program: Background and Issues for Congress». CRS Report, RL30563. Washington: Congressional Research Service, 27/11/2009, pp. 12-15. https://fas.org/sgp/crs/weapons/RL30563.pdf.

58 Distribution proportional to the economic contribution of each country, seen as a focal point of Schelling (1960), without which it would be difficult to reach an agreement even if it could produce an inefficient division of labour and the reduction of common benefits. SCHELLING, T. C. The Strategy of Conflict. Cambridge, Massachusetts: Harvard University Press 1960.

59 HAYWARD, K. Op. cit., p. 19.

60 WALKER, W.; GUMMETT, P. Op. cit., pp. 22-25.

61 RICH, M. et al. «Multinational Coproduction of Military Aerospace Systems». RAND Paper, R-2861. Santa Monica, CA: RAND 1981, pp. 103-104.

over several years and in various programmes, ensuring at least sixty-six per cent of their financial contribution, allowing the rest to be allocated on the basis of the best market proposals. However, an inherent problem is that it gives preference to the industries of OCCAR member states rather than opening up to the EU market as a whole[62]. In this regard, OCCAR is beginning to suffer operational pressures, because some programmes managed under its auspices, such as the A400M, have suffered delays and shortfalls in agreed capacities leading to the renegotiation of the contract and increased funding, mainly due to technical problems[63], similar to those in the American programmes JSF and C-17. This situation affects the confidence of the countries concerned and generates uncertainty as to the efficiencies expected from the use of this model. It could even manifest the same problems as previous labour-sharing formulas. Therefore, the continuous intervention in the market to achieve this adjustment between the various states has limited the establishment of a true European Defence Equipment Market (EDEM)[64], by distributing work based on economic contribution instead of opening it up to technological and industrial competition in the market. As an alternative, there is the concept of Earned Workshare, based on competitive tendering, i.e. participation based on experience and proven skills. In this way, the collaborating companies contribute according to their strengths, being forced to specialise to guarantee their survival in the market, which implies a reform of the European defence industry and increased transnational dependence, interdependence and reciprocity. In this sense, if the relationship between financing and work-sharing were completely eliminated and work was allocated to the companies that present the most competitive offers, governments could concentrate on agreeing on the high-level performance requirements, such as speed, autonomy or scope, leaving the low-level specifications in the hands of the industry, thus improving the economic efficiency of the joint programmes by simplifying unanimous decision- making[65]. However, right now, this concept would mean radical reform in the design of collaboration programmes, with the challenge of convincing potential partners to agree to this new type of social contract without ensuring industrial participation equivalent to their investment. In this scenario, the creation of the EDF, where the EU is contributing money, allows all nations the opportunity to participate and benefit from the development of a joint programme even if they have reduced industrial capacities.

62 TRYBUS, M. Buying Defence and Security in Europe. The EU Defence and Security Procurement Directive. Cambridge: Cambridge University Press 2014, p. 224.

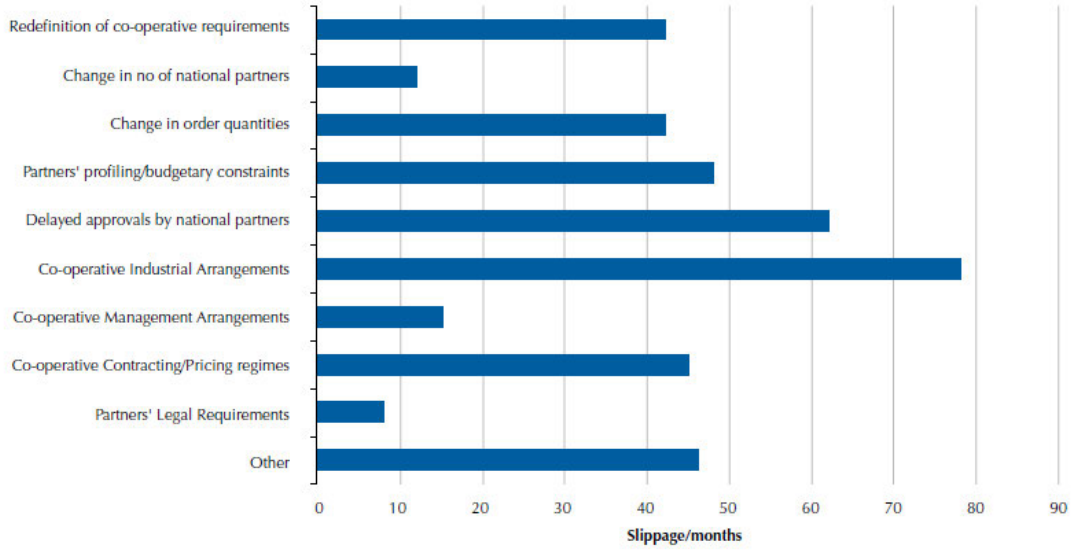
63 REUTERS. Op. cit. https://www.reuters.com/article/us-singapore-airshow-a400m/airbus-says-a400m-deal-with-buyers-will-limit-future-losses-idUSKBN1FR19Y.

64 EDGAR, A. D.; HAGLUND, D. G. The Canadian Defence Industry in the New Global Environment. Montreal: McGill-Queen's University Press 1995, p. 27.

65 KEOHANE, D. The EU and armaments co-operation. London: Centre for European Reform 2002, p. 25.

Costs and delays over unanimous decision-making

Generally speaking, international collaboration programmes incur delays prior to their launch due to the establishment of the programme, harmonisation of requirements, obtaining funding and agreement on the division of labour between the industries in the partner states, delivery deadlines and national procurement procedures[66] [67], together with the need for consensus among participating states in decisions affecting programme development. By way of example, the following graph includes the cooperative factors that have been the main cause of the average total delay in collaborative programmes in which the British Ministry of Defence has participated.



Graph 2. Factors causing delays in the UK Ministry of Defence cooperative procurement programmes[68].

In this graph we see how delays in industrial agreements and national approvals are the causes of postponement with the greatest impact on planning. This is closely followed by delays in securing the necessary funds for future phases of the programme, resulting from the financial profiles and budgetary restrictions of the different participating states, together with the redefinition of requirements, the withdrawal of some states, or the reduction in the number of orders. As a result, these programmes generally show an increase in their duration in proportion to the cubic root of the number of participating countries and an increase in cost in relation to the square root[69], as a result of these delays and the main factors driving them, in addition to having a

66 RICH, M. et al. Op. cit., pp. 87-88.

67 LORELL, M. A. «Multinational Development of Large Aircraft: The European Experience». RAND Paper, R-2596. Santa Monica, CA: Rand 1980, p. 5.

68 NAO. Op. cit., 2001, fig. 14.

69 For example, in programmes involving four states, the cost would be double that of an equivalent national programme.

negative impact on economies of scale[70]. The *TRIGAT* programme discussed above, for example, was delayed because nations underestimated the time needed to reach administrative and industrial agreement and obtain national approval to proceed with future phases. Another example is the JSF programme with delays of up to thirty months in its planning compared to the initial estimate[71], and cost increases due to different causes, both technical and in terms of consensus (see table and graph below).

Year	Total estimated cost [millions of dollars]	Total annual estimated cost increase [%]	Number of planes	Average unit cost [millions of dollars]	Main cause of variation total estimated cost
2001	From 218,554 to 226,458	+3.6	2,886	78.47	Delayed decision on the development and demonstration phase of the system, inclusion of two flight test aircraft and a new cost estimate model [72]
2002	199,736	-11.8	2,457	81.29	Decrease of 409 Navy aircraft [73]
2003	244,834	+22.6	2,457	99.65	Revised labour costs and contractor overheads, extended development phase for additional design development, delayed start of procurement from 2006 to 2007 and delayed contractor production scheduling[74]
2004	256,617	+4.8	2,458	104.40	Further design development, refined definition of support requirements and delay in initial procurement from 2007 to 2008 with a revised purchase profile for all variants[75]
2005	276,458	+7.7	2,458	112.47	Increased cost of fuselage materials, review of inflation impact, review of work shared between prime contractor and subcontractors, configuration update, change in sub-contract manufacturing plan for the wing, and realignment of funds due to budget reductions[76]

70 FONTANEL, J.; SMITH, R.; BOLTON, P. «A European Defence Union?». Economic Policy, 6 (13). 1991, pp. 406–409. JSTOR, www.jstor.org/stable/1344631.

71 GAO. Op. cit., 2009, p. 18. www.gao.gov/new.items/d09711t.pdf.

72 OUSD (AT&L). Selected Acquisition Report (SAR) Summary Tables. Washington: 2002, pp. 10-11. https://www.acq.osd.mil/ara/am/sar/2001-Dec-SARSUMTAB.pdf.

73 OUSD (AT&L). SAR. 2003, p. 8. http://www.acq.osd.mil/ara/am/sar/SARST1202.pdf.

74 OUSD (AT&L). SAR. 2004, p. 5. http://www.acq.osd.mil/ara/am/sar/2003-Dec-SST.pdf.

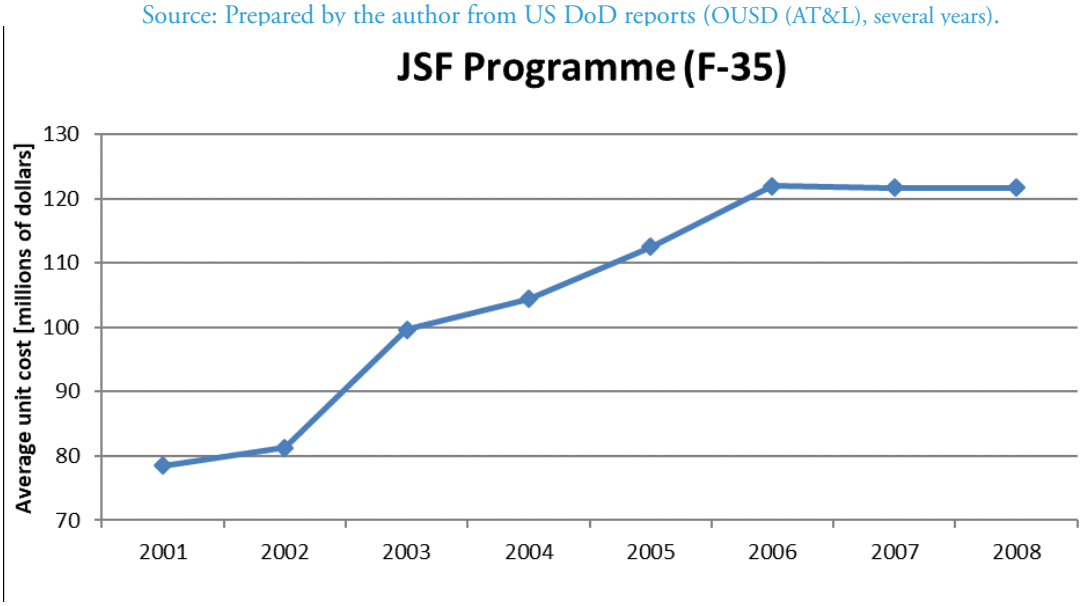
75 OUSD (AT&L). SAR. 2005, pp. 8-9. http://www.acq.osd.mil/ara/am/sar/2004-DEC-SST.pdf.

76 OUSD (AT&L). SAR. 2006, p. 9. http://www.acq.osd.mil/ara/am/sar/2005-DEC-SST.pdf.

2006	299,824	+8.5	2,458	121.98	Decrease in annual purchase quantities, increase in purchase lead time from 2027 to 2034, update of aircraft configuration, revision of acquisition profile[77]
2007	298,842	-0.3	2,456	121.68	Application of revised escalation rates, lower material estimates in prime contractor agreements, incorporation of revised labour costs [78]
2008	298,842	-	2,456	121.68	Unchanged[79]

Table V. *JSF* programme increases and main causes (2001-2008).

Source: Prepared by the author from US DoD reports (OUSD (AT&L), several years).



Graph 3. Evolution of the estimated unit cost of the JSF programme (F-35) Source: prepared by the author.

An in-depth and judicious assessment of the associated costs and potential benefits of international cooperation programmes is essential for consideration. An erroneous assessment based on excessive optimism can negatively affect the development of the programme as well as future opportunities for international collaboration, and resulting in decisions that are inappropriate both for the states involved and for economic-political relations.

Withdrawal of a member state

The different factors limiting international collaboration explored in previous sections of this article can lead to states withdrawing from a programme at any stage, even before its launch, causing a reorganisation of work, delays and associated costs

77 OUSD (AT&L). SAR. 2007, p. 7. http://www.acq.osd.mil/ara/am/sar/2006-DEC-SST.pdf.

78 OUSD (AT&L). SAR. 2008a, p. 6. http://www.acq.osd.mil/ara/am/sar/2007-DEC-SST.pdf.

79 OUSD (AT&L). SAR. 2008b. http://www.acq.osd.mil/ara/am/sar/.

that generate instability and inefficiency in contracts and a climate of distrust for future cooperation, as seen in the section on unsuccessful cases.

Conclusions

Despite the fact that collaboration in European armament programmes is over seventy years old, the commitment to industrial collaboration is not a trivial issue as has been observed in the cases analysed. It has been demonstrated that the harmonisation of national requirements to establish a common specification remains one of the main stumbling blocks along with the division of labour, since, from a political and national sovereignty perspective, arms-producing states have historically sought to protect their national industrial fabric and their respective expertise in key technologies and highly skilled jobs, resulting in the existence of some 180 different weapons systems in the EU in 2016, compared to 30 in the USA.[80]

However, from a technological, industrial and economic perspective, the current environment of globalisation, an ongoing increase in technological complexity and the growing average cost of defence systems and equipment, make purely national developments less viable. In this sense, collaboration favours the increase of common investment in research and development, avoiding duplication of efforts and favouring the existence of larger production series, thus taking advantage of economies of scale. In this sense, for the purpose of creating a European Defence Equipment Market (EDEM) and giving strong support to the EU industrial fabric, over the last few years the Commission has launched different initiatives such as the European Defence Fund (EDF), within the European Defence Action Plan (EDAP)[81], and the launch of a new European Defence Industrial Development Programme (EDIDP) from 2019, in addition to PESCO established in 2017, with the aim of jointly achieving the development and acquisition of defence goods and capabilities. All these initiatives will provide greater transparency on defence capabilities, shortfalls and future needs at EU level, facilitating the allocation of resources and the development of joint defence capabilities under the CSDP in an atmosphere of trust and smooth communication between the parties. Moreover, they are designed to favour the identification of future opportunities for industrial cooperation, increased competitiveness in the sector at European level and reduced dependence on the US, together with the ability to act as a catalyst for industrial restructuring that will rationalise the number of prime contractors, promote specialisation, improve their international competitiveness and strengthen the EU's security relations and security and defence identity.

80 MSC. «Munich Security Report 2017: Post-Truth, Post-West, Post-Order?». Munich Security Report (MSC). 2017, p. 21. www.eventanizer.com/MSR/MSC2017/.

81 Developed between the Commission, the European External Action Service (EEAS) and the European Defence Agency (EDA).

In this new scenario, it is recommended that partner states coordinate their needs to foster international industrial cooperation, taking advantage of the collaborative projects approved by the Council within the framework of PESCO and financed by the EDF. These projects provide an opportunity to strengthen international security and defence relations and to share risks, efforts and resources to jointly analyse, develop and produce more advanced equipment and systems – difficult to obtain nationally mainly due to the lack of industrial capabilities – and to strengthen skills in key technological areas by taking advantage of common investment in innovation and development, and also making savings by appropriating part of the economies of scale.

Analysing existing mechanisms, such as the European Defence Fund (EDF) and the European Defence Industrial Development Programme (EDIDP), coupled with the increase in the proposed funding of 13 billion euros for the period 2021-2027 – pending Council approval and Parliament's consent, a figure very likely to be reduced due to the departure of the United Kingdom from the EU (Brexit), and the Finnish proposal[82] at the end of 2019 to reduce the EDF by half – gives credibility to the new scenario established so far. Thus, the Commission is opting for the use of an economic-financial formula to encourage cooperation by applying different incentives to collaboration projects involving at least three member states – thereby avoiding duopolies – where a minimum of three different companies collaborate and where there is integration of SMEs from different countries in consortiums and as subcontractors, as well as an additional incentive if these projects are developed within the framework of PESCO. In this way, the new European institutional context and the existing mechanisms represent for the first time a serious commitment on the part of the EU, which is considered ideal in the current scenario to promote industrial competition and to favour the path towards the establishment and consolidation of a true European Defence Equipment Market (EDEM). It must be acknowledged that in recent years the EU has taken firm steps to promote defence cooperation in the EU, but there is still a long way to go.

For future research work, we recommend a detailed analysis of the situation of the Spanish State in comparison with the remainder of the partner states in terms of participation and the outcomes of the cooperation programmes in which Spain has collaborated, as well as the internal initiatives to be promoted in order to place Spain in a more dominant position in the future of European defence collaboration initiatives and programmes[83].

82 See, Note to the MFF/OR negotiating team. Decoding the Finnish presidency numbers: a preliminary analysis of the MFF negotiating box. Committtee on Budgets European Parliament, 11/12/2019. https://www.europarl.europa.eu/resources/library/media/20191213RES69015/20191213RES69015.pdf.

83 In the first 47 PESCO projects, France, Italy and Spain are the countries most involved. France participates in 30 projects, heading up 10; Italy participates in 26 projects, heading up 9; and Spain participates in 24 projects, heading up 2. https://www.consilium.europa.eu/media/41333/pesco-projects-12-nov-2019.pdf.

Bibliography

AIRBUS. «Orders, Deliveries, In Operation Military Aircraft by Country – World-Wide». *Airbus.com*. 30/04/2018. http://www.airbus.com/defence.html.

ARENA, M. V. et al. *Why Has the Cost of Navy Ships Risen? A Macroscopic Macroscopic Examination of the Trends in US Naval Ship costs over the Past Several Decades.* Santa Monica, CA: RAND 2006.

ARENA, M. V. et al. *Why Has the Cost of Fixed-Wing Aircraft Risen? A Macroscopic Examination of the Trends in U.S. Military Aircraft Costs over the Past Several Decades.* Santa Monica, CA: RAND 2008.

BLEAKLEY, G. A. *International Armaments Cooperation: A Case Study of the Modular Standoff Weapons.* Thesis. Ohio: Wright-Patterson Air Force Base 1988.

BRZOSKA, M.; LOCK, P. *Restructuring of Arms Production in Western Europe*. *SIPRI Monographs*. United States: Oxford University Press 1992.

CATINGTON, R. C.; KNUDSON, O. A.; YODZIS, J. B. *Transatlantic Armaments Cooperation: Report of the Military Research Fellows, DSMC 1999-2000*. Fort Belvoir, VA: Defense Systems Management College 2000.

DATAQUEST. «Military Electronic Systems Markets». *Dataquest*. San José: CA 1991.

DEFENCEWEB. «First export success for the COBRA Radar in Gulf region». *DefenceWeb.co.za*. 25/02/2009. http://www.defenceweb.co.za/index.php?option=com_content&view=article&id=1165.

DEFENSA. «La DGAM convocará un polémico concurso para comprar un avión que remplace a los C101 del Ejército del Aire». *Defensa.com.* 12/07/2019. www.defensa.com/espana/dgam-convocara-inminentemente-polemico-concurso-para-comprar.

EDGAR, A. D.; HAGLUND, D. G. *The Canadian Defence Industry in the New Global Environment.* Montreal: McGill-Queen's University Press 1995.

EURO-ART. «Roll-out of 29 COBRA Systems for France, Germany and the United Kingdom completed». *thalesgroup.com.* 2007. http://www.defense-aerospace.com/articles-view/release/3/85494/cobra-radar-deliveries-now-complete.html.

EXPANSIÓN. «Airbus quiere revitalizar el A400M, el avión militar de los 20.000 millones». *Expansion.com.* 10/07/2018. www.expansion.com/empresas/transporte/2018/07/10/5b43be04268e3e2e428b460b.html.

FLIGHT INTERNATIONAL. «VAK 191B cancelled…». *Flight International.com*. 7/12/1972. https://www.flightglobal.com/FlightPDFArchive/1972/1972%20-%203225.pdf.

FONTANEL, J.; SMITH, R.; BOLTON, P. «A European Defence Union?». *Economic Policy*, 6 (13). JSTOR 1991, pp. 393–424. www.jstor.org/stable/1344631.

GAO. «Tactical Aircraft: Changing Conditions Drive Need for New F/A-22 Business Case». *Report GAO-04-391*. Washington: U.S. Government Accountability Office (GAO) 2004.

GAO. «Joint Strike Fighter - Strong Risk Management Essential as Program Enters Most Challenging Phase». *Report GAO-09-711T*. U.S. Government Accountability Office (GAO), *GAO.gov*., 2009. www.gao.gov/new.items/d09711t.pdf.

GE AVIATION. «GE and TAI Extend Tusas Engine Industries, Inc. Joint Venture for Another 25 Years». *GEAviation.com*. 29/01/2010. https://www.geaviation.com/press-release/services/ge-and-tai-extend-tusas-engine-industries-inc-joint-venture-another-25-years.

GERTLER, J. J. «F-35 Joint Strike Fighter (JSF) Program: Background and Issues for Congress». *CRS Report, RL30563*. Washington: Congressional Research Service, 27/11/2009. https://fas.org/sgp/crs/weapons/RL30563.pdf.

GLOBALSECURITY. «MBT-70/XM803». *Globalsecurity.org*. 2011. https://www.globalsecurity.org/military/systems/ground/mbt-70.htm.

GLOBALSECURITY. «NATO Frigate Replacement for the 1990s [NFR-90]». *Globalsecurity.org*. 2013. https://www.globalsecurity.org/military/world/europe/nfr-90.htm.

GLOBALSECURITY. «Multi-Role Armoured Vehicle (MRAV)». *Globalsecurity.org*. 2016. https://www.globalsecurity.org/military/world/europe/mrav.htm.

HARTLEY, K. «The European Defence Market and Industry». En P. Creasey y S. May, (eds.). *The European Armaments Market and Procurement Cooperation*. London: Palgrave Macmillan 1988.

HARTLEY, K. *The industrial and economic benefits of Eurofighter Typhoon.* United Kingdom: Universidad de York 2006.

HARTLEY, K. *The Economics of Defence Policy: A new perspective.* London: Routledge 2011.

HAYWARD, K. «Towards a European Weapons Procurement Process: The Shaping of Common European Requirements for New Arms Programmes». *Chaillot Paper*, 27. France: Institute for Security Study of WEU 1997.

INFODEFENSA. «Eurofighter Typhoon for Belgium - Media Guide, BAE Systems». *Infodefensa.com*. 07/10/2016, p. 6. https://www.infodefensa.com/archivo/files/161007_eurofighter_belgica%20(1).pdf

JAARSMA, M. «A400M». *Phantomaviation.nl.* 2018. www.phantomaviation.nl/Aircraft/A400M.htm.

JAARSMA, M. «NH90». *Phantomaviation.nl.* 2018. www.phantomaviation.nl/Aircraft/NH90.htm.

JOHNSON, E. L. *Howitzer Ammunition System Procurement (HASP).* Alexandria, Virginia: U.S. Army Material Command 1991.

KEOHANE, D. *The EU and armaments co-operation.* London: Centre for European Reform 2002.

LARSON, E. *et al. Interoperability of US and NATO Allied Air Forces: Supporting Data and Case Studies.* RAND 2003. www.rand.org/content/dam/rand/pubs/monograph_reports/2005/MR1603.pdf.

LORELL, M. A. «Multinational Development of Large Aircraft: The European Experience». *RAND Paper, R-2596.* Santa Monica, CA: Rand 1980.

LORELL, M. A. *The Use of Prototypes in Selected Foreign Fighter Aircraft Development Programs.* Santa Monica, CA: RAND 1989.

MSC. *Munich* «Security Report 2017: Post-Truth, Post-West, Post-Order?». *Munich Security Report (MSC)*. 2017. www.eventanizer.com/MSR/MSC2017/.

NAO. *Maximising the benefits of defence equipment co-operation*. National Audit Office (NAO), Ministry of Defence, Report by the Comptroller and Auditor General, HC 300 Session 2000-2001, London: The Stationery Office 2001.

NAO. *Major Projects Report 2005.* London: National Audit Office (NAO) 2005.

NAO. *Management of the Typhoon Project.* Report by the Comptroller and Auditor General HC 755 Session 2010–2011. London: National Audit Office (NAO) 2011.

NRAC. *Life cycle technology insertion*. Washington: The United States Naval Research Advisory Committee (NRAC) 2002.

OCCAR. *TIGER – A New Generation of Helicopters.* 2018. www.occar.int/programmes/tiger.

OUSD (AT&L). *Selected Acquisition Report (SAR) Summary Tables*. Washington: 2002. https://www.acq.osd.mil/ara/am/sar/2001-Dec-SARSUMTAB.pdf.

OUSD (AT&L). SAR. 2003. http://www.acq.osd.mil/ara/am/sar/SARST1202.pdf.

OUSD (AT&L). SAR. 2004. http://www.acq.osd.mil/ara/am/sar/2003-Dec-SST.pdf.

OUSD (AT&L). SAR. 2005. http://www.acq.osd.mil/ara/am/sar/2004-DEC-SST.pdf.

OUSD (AT&L). SAR. 2006. http://www.acq.osd.mil/ara/am/sar/2005-DEC-SST.pdf.

OUSD (AT&L). SAR. 2007. http://www.acq.osd.mil/ara/am/sar/2006-DEC-SST.pdf.

OUSD (AT&L). SAR. 2008a. http://www.acq.osd.mil/ara/am/sar/2007-DEC-SST.pdf.

OUSD (AT&L). SAR. 2008b. http://www.acq.osd.mil/ara/am/sar/.

PISANO, G. P. «The R&D Boundaries of the Firm: An Empirical Analysis». *Administrative Science Quarterly*, 35 (1). 1990.

REUTERS. «Airbus says A400M deal with buyers will limit future losses». *Reuters.com.* 07/02/2018. https://www.reuters.com/article/us-singapore-airshow-a400m/airbus-says-a400m-deal-with-buyers-will-limit-future-losses-idUSKBN1FR19Y.

RICH, M. *et al.* «Multinational Coproduction of Military Aerospace Systems». *RAND Paper, R-2861*. Santa Monica, CA: RAND 1981.

RUIZ, R. M. «El último vástago del programa NFR-90». *Revista Ejércitos*, 5. 2010. https://issuu.com/ejercitos/docs/revista_ejercitos_n_5?q=NFR-90.

SCHELLING, T. C. *The Strategy of Conflict. Cambridge*. Massachusetts: Harvard University Press 1960.

SMITH, D. *Weaponry after the Gulf war - New equipment requirements for restructured armed forces*. Document 1272, 14/05/1991. http://aei.pitt.edu/53851/1/B0979.pdf.

TAYLOR, T. *Defence, Technology and International Integration*. NY: St. Martin's Press 1982.

TAYLOR, T. «West European Defence Industrial Issues for the 90's». *Defence Economics*, 4. 1993.

THINK DEFENCE. «Javelin Anti-Tank Guided Weapon (ATGW). UK Complex (Guided) Weapons – Reference». *ThinkDefence.co.uk.* 2018. https://www.thinkdefence.co.uk/uk-complex-weapons/javelin-anti-tank-guided-weapon-atgw/.

THINK DEFENCE. «Storm Shadow Conventionally Armed Stand Off Missile (CASOM)». *ThinkDefence.co.uk.* n.d. www.thinkdefence.co.uk/uk-complex-weapons/storm-shadow-conventionally-armed-stand-off-missile-casom/.

TRYBUS, M. *Buying Defence and Security in Europe. The EU Defence and Security Procurement Directive.* Cambridge: Cambridge University Press 2014.

TUCKER, J. B. «Partners and Rivals: A Model of International Collaboration in Advanced Technology». *International Organisation*, 45 (1). 1991.

VOSS, W.; BRZOSKA, M. *Eurofighter 2000: Consequences and Alternatives.* Bonn-Germany: BICC 1996.

WALKER, W.; GUMMETT, P. «Nationalism, internationalism and the European defence market». *Chaillot Papers,* 9. Paris: Institute for Security Studies of WEU 1993.

WILLIS, F. R. *France, Germany, and the New Europe, 1945-1967.* California: Stanford University Press 1968.

WOOD, D. *Project Cancelled: Disaster of Britain's Abandoned Aircraft Projects.* London: Macdonald and Jane's Publishers 1975.

– *Submited: March 03, 2020.*
– *Accepted: May 22, 2020.*